

TIGHT DESICCANT CONTAINER FOR PACKAGING PRODUCTS
SENSITIVE TO AMBIENT MOISTURE

Field of the invention

The invention relates to a desiccant container made particularly tight with respect to moisture and designed for the packaging of products sensitive to ambient moisture, said products possibly being materials, presented in forms as diverse as powders, granules, tablets, particularly for effervescent, coated or agglomerated products, and items liable to be presented in diverse forms, particularly oblong forms.

The invention relates more specifically to a desiccant container made particularly tight with respect to moisture and designed for the packaging of products sensitive to ambient moisture, particularly medicinal products, said container having a tubular shape, being closed by means of a cap-lid connected to the tubular part by means of a hinge and being provided with internal desiccant means, which are renewable if applicable.

The materials sensitive to moisture which must be packaged in a desiccant container are, typically, medicinal products, particularly effervescent products,

which it is desirable to protect so that the efficiency thereof does not change through a reaction with water vapour and/or so that the physical integrity thereof is retained over time, thus preventing a change in the mechanical cohesion thereof, for example.

The items particularly of oblong shape have a substantially polygonal, circular, elliptical, elongated cross-section and are used as consumables. Such items are, in particular, tabs, test strips in the form of strips or rigid slides used for example for diagnostic or testing purposes in the medical field, wound dressings or food products such as chewing gums, tooth picks, sticks or others.

For obvious reasons, particularly hygiene, but also in order to avoid any degradation and thus improve the shelf-life of products, they are placed protected from physico-chemical corrosion resulting from the level of relative humidity, but also from light, particularly UV radiation and other chemical substances, or degradation due to a mechanical effect.

State of the related art

The definition of the prior art demonstrates the existence of numerous desiccant containers designed to receive and contain products sensitive to ambient moisture wherein they must be protected by creating the driest possible internal ambient atmosphere, to prevent said products from absorbing moisture which could react with said products or induce the mechanical shock-induced brittleness thereof, or the disintegration or decomposition thereof in the container due to the absorption of ambient moisture.

The products particularly sensitive to ambient moisture are numerous and may be more specifically medicinal product materials or test items including those more specifically with a particular sensitivity to moisture and which are presented in powder forms or in more complex forms such as granules, tablets, lozenges, oblong-shaped items such as test strips or other items.

These desiccant and tight containers for the storage of products sensitive to ambient moisture are generally of a tubular shape, are sealed with a removable cap or lid attached or not to the tubular part by attachment means such as a connection with a narrow strip of polymer material identical to that of the container and the cap, and are equipped with internal desiccant means which are produced using a desiccant thermoplastic polymer formulation, placed inside the containers on the inner surface of the tube base and/or on the inner surface of the side wall of the tube, in the form of an insert or a coating or in the form of a desiccant granular material placed in a special housing on the inner surface of the cap.

All these desiccant means are fitted separately or simultaneously to increase the efficiency of the dehydrating action thereof by a mass effect.

These containers are formed by:

- a tubular casing equipped with a base on one of the ends, the other end being open to enable the filling of said casing,
- and sealing means which may be a removable cap fitting into the open end of said tubular casing, or a lid-cap also fitting into said open end, but connected to

the tubular casing by a flexible connection such as a narrow polymer strip acting as a hinge.

All these containers and their removable caps or lid-caps are produced using thermoplastic polymer formulations according to well-known plastics techniques.

Desiccant containers for packaging materials and/or items sensitive to ambient moisture are described in the prior art and are essentially distinguished from each other by the desiccant means used in said containers and by the structure of the container sealing means.

According to a first type of desiccant container of the prior art, the container is formed by a tubular casing open at one end to give access to the receptacle zone, said open tubular casing being closed after the filling thereof with a (female type) cap-lid made integral with the casing by means consisting of a narrow polymer material connection strip.

A first document (EP 0824 480) discloses such a desiccant container comprising:

- a tubular casing made of thermoplastic polymer material equipped with a base at one of the ends thereof and open at the other end which covers, in the closed position, the wall of the open end of the casing,

- a female type lid, with a descending skirt, which covers, in the closed position, the open end of the casing, the tightness being liable to be ensured by the contact of the inner surface of the skirt with the outer surface of the open end of the tubular casing, said lid being produced from the same thermoplastic polymer material as the casing and connected to the casing by means of a connection consisting of a narrow polymer strip, the casing, lid and connection between the lid and

the casing being a single piece, produced during a single plastics technology operation, by injection moulding for example,

- a desiccant insert formed by a thermoplastic polymer material filled with desiccant materials, consisting of a material other than that forming the casing, lid and connection between the casing and the lid, said insert possibly occupying the base of the tubular casing or covering the base and inner wall of said casing simultaneously.

However, this type of container does not appear to be able to carry out rapid and continuous drying of the packaged materials to be protected because:

- each time the container is opened to remove part of the packaged materials, e.g. a pill, tablet, strip, the outer ambient air charged with its relative humidity enters the casing. As the lid is closed, the volume of moist ambient air occupies the gap between the closed lid and the top layer of the packaged moisture-sensitive materials. However, when the casing is filled with said packaged moisture-sensitive materials, said materials covers zones comprising the desiccant thermoplastic polymer forming a screen, blocking, or preventing the exchange between the desiccant thermoplastic polymer and the volume of moist ambient air enclosed in the casing; for this reason, the moisture is absorbed preferentially by the packaged moisture-sensitive materials as they are in direct contact with the water vapour naturally present in the volume of ambient air present in the container after its has been opened and closed,

- the lid is not particularly suitable for the creation of increased tightness between the inside and

outside of the container, due to its architecture, but also due to its flexible connection means with the casing, which does not make it possible to position the lid when it is closed due to this high flexibility of the connection means and, as a result, the lack of sufficient mechanical rigidity both longitudinally and laterally, necessary to guide said lid when it is being closed.

According to another type of desiccant container of the prior art, the container is formed by a tubular casing closed at one of the ends and open at the other end, said opening being closed after filling the casing with a male type removable cap.

A document (EP 0454 967) discloses such a desiccant container consisting of:

- a tubular casing made of thermoplastic polymer material equipped with a base at one of the ends thereof and open at the other end, wherein the inner surfaces of the base and the lateral wall of said casing are coated with a dehydrating desiccant polymer composition formed by a mixture of a thermoplastic polymer and an incorporated dehydrating powder filler,

- a removable male type cap also made of a thermoplastic polymer material, with a descending skirt, which, once in the closed position, is liable to establish the inner tightness of the container by means of the contact of the outer surface of the cap skirt with the inner surface of the casing,

- the removable cap is formed by a base combined with the above mentioned skirt which together delimit a cavity capable of receiving an insert produced using the desiccant polymer composition, formed by the mixture of a thermoplastic polymer material and a powder desiccant

material, said insert possibly being a pellet adherent to the inner surface of the base of the cap or an insert of a complex shape, consisting of cylindrical surfaces or parts of cylindrical surfaces which are coaxial with the
5 cap.

However, this type of container does not seem to be able to provide improved rapid, continuous drying, which is as complete as possible, of the moisture-sensitive materials packaged in this container to be dehydrated and
10 protected.

Indeed, each time the container is opened, the phenomenon described above consisting of the introduction of a charged gaseous volume wherein the relative humidity level is greater than the relative humidity level to be
15 applied inside the container, occurs.

As in the case of the first mentioned document, the phenomenon already described is reproduced in the same way when the removable cap is not equipped with a desiccant insert. However, when the removable cap is
20 equipped with a desiccant insert, the absorption kinetics of the moisture introduced into the container, by means of an opening/closing cycle, is improved, but it seems that the time required to achieve the lowest possible relative humidity level inside the container is still too
25 long and that this phenomenon is the consequence of both an insufficient tightness capacity of the male type removable cap and the low absorption kinetics of the desiccant insert produced by means of a desiccant polymer composition.

30 The cap does not seem to be particularly suitable for the creation of increased internal tightness to moisture, probably due to leakage phenomena from the

outside to the inside of the container, even at very low rates, associated with pressure variations between the outside and the inside of the tube, a moist flow which is captured both by the dehydrating insert of the removable
5 cap, but also by the moisture-sensitive materials packaged in the container.

Another document (GB 248,223) discloses a male type removable desiccant cap to seal a container formed by a casing closed at one of the ends and open at the other.

10 This removable cap consists of a base combined with two peripheral skirts, one external and the other internal, forming together and with the associated base a groove capable of receiving the peripheral edge of the open end of the casing.

15 This removable cap is provided with a cavity delimited by its base and the inner peripheral skirt, which can receive an insert produced by means of a desiccant composition.

However, this type of removable cap appears to be
20 rudimentary and incapable of providing a technological improvement, as the tightness between the cap and the peripheral edge of the casing to be sealed is very basic and supposed to be produced by means of an annular flat seal placed on the flat base of the cap, while the inner
25 and outer skirts of the cap which are not in contact with the inner and outer walls of the open end of the container to be sealed, have no tightness action, but only, for the outer skirt, a snap-on action of said cap onto an annular protuberance external to the casing of
30 the container created to produce said snap-on action.

According to another type of desiccant container of the prior art, the container is formed by a tubular

casing open at one of its ends to give access to the receptacle zone, said open tubular casing being closed after filling by a male type lid-cap, connected to the tubular casing by mechanical means consisting of a ring encircling by force the tubular casing and a narrow connection strip between the lid-cap and the ring.

A document (US P 4,934,556) discloses such a desiccant container, comprising:

- a tubular thermoplastic polymer material casing equipped with a base at one of its ends and open at the other end, serving as a receptacle for the materials to be packaged,

- a lid-cap belonging to an assembly formed by a ring encircling the casing by force, a tamperproof indicator, to be pulled off, connecting the ring encircling the outer periphery of the cap and a narrow connection strip between the lid-cap and said ring.

The male type lid-cap is formed by a base and a peripheral skirt which delimit a cavity capable of receiving a reserve of powder desiccant agent, not incorporated into a polymer matrix, and as such in direct contact with the internal gaseous medium to be dried.

This type of desiccant container for the packaging of moisture-sensitive products also involves uncertainties with respect to its ability to ensure rapid and complete drying of said products during the opening-closing of said packaging container. This appears to be:

- the result of insufficient tightness between the male type lid-cap and the tubular casing, the architecture of said cap-lid not appearing to be sufficiently suitable to achieve tightness of the container when external-internal exchange of moisture-

charged gaseous volumes that it is important to dry rapidly are liable to occur,

- also, at least partly, the result of the flexible connection means between the lid-cap and the ring encircling the casing by force, said means which consist
5 of a narrow polymer material strip not enabling suitable positioning for the proper closure of the casing due to the lack of guiding thereof prior to said closure.

Another document (GB 812,580) discloses a device to
10 seal a container (particularly a bottle), which cannot be desiccant, consisting of a cap-lid, peripheral attachment means on the mouth of the container to be sealed and a hinge-film between the cap-lid and the peripheral attachment means of the device, the cap-lid and the
15 attachment means being attached by a safety tab removed at the first opening.

The closure device is provided with two peripheral skirts forming a groove, covering the mouth of the container.

20 The outer skirt intended to cover the outer surface of the container casing consists of three parts:

- the upper casing forming the outer peripheral skirt of the cap-lid;

- another lower part forming the peripheral means of
25 the outer attachment onto the mouth of the container;

- the median part which is formed by the peripheral safety tab, removed at the first opening, with the exception of the connection zone forming the hinge-film between the upper part and the lower part.

30 If the device is intended to seal a bottle, the upper part of the outer peripheral skirt is equipped with

a peripheral seal following the shape of the bottle mouth section.

The inner cylindrical or tapered type skirt, according to the container to be sealed, is equipped in
5 its lower part with a peripheral triangular cross-section seal which comes into contact with the inner surface of the mouth of the container during sealing.

However, this type of device does not appear to be able to provide increased tightness, or to be able to be
10 fitted to a desiccant container for packaging materials and/or items sensitive to ambient moisture, as the cap-lid is not suitable for the creation of increased tightness between the inside and outside of the container, due to its architecture, as the inner skirt of the cap is
15 only in contact with the inner surface of the mouth of the container via the triangular peripheral seal which acts by means of a tangential contact and not surface to surface contact.

In fact, a completely free and non-tight annular
20 space developing between the triangular seal and the peripheral tangential contact of the groove base with the mouth of the container occurs in this device.

In this way, tightness can only be ensured by a surface to surface type contact between only the inner
25 surface of the outer skirt of the cap and the outer surface of the mouth of the container, this type of contact being insufficient to enable increased tightness as it is too sensitive to external mechanical stress liable to create gaseous leakage phenomena due to the
30 deformation of said device.

In this way, it appears that none of the desiccant containers according to the state of the art gives

sufficiently satisfactory results to package products sensitive to relative moisture under optimum conditions.

Objective of the invention

5 Numerous objectives are assigned to the desiccant container according to the invention, such that it can eliminate as much as possible the abovementioned drawbacks and provides suitable and improved solutions with respect to the various means used in the desiccant
10 containers described in the prior art.

 A first object of the invention is to produce a desiccant container closed by sealing means which have a novel architecture ensuring increased tightness between said sealing means and the tubular casing.

15 A further object of the invention is to produce a desiccant container closed by sealing means with increased tightness having an adsorption kinetics of the water vapour present in said container superior to those observed in the prior art, i.e. with a greater capacity
20 to adsorb the excess moisture created during the opening and closing of the desiccant container, to prevent the packaged moisture-sensitive products from adsorbing all or part of said excess moisture.

 A further object of the invention is to produce a
25 desiccant container closed by sealing means with increased tightness having the ability to maintain the relative moisture level inside the desiccant container at a low and relatively constant level, other than in opening/closing cycles, to provide optimum protection of
30 the packaged moisture-sensitive products.

 A further object of the invention is to produce a desiccant container closed by sealing means with

increased tightness wherein the sealing means are connected to the container by connection means capable of facilitating and guiding the closure of the sealing means so that said closure is particularly tight with respect to any gaseous exchange from the outside to the inside of the desiccant container.

Summary of the invention

All the above mentioned objectives can be achieved by the desiccant container according to the invention to package processed or unprocessed products, sensitive to ambient moisture.

According to the invention, the desiccant container, with increased tightness, made of thermoplastic polymer materials, for the packaging of products sensitive to ambient moisture, presented in processed or unprocessed forms, consisting of:

- a tubular casing, closed at one of its ends by a base and open at the other end, to form the mouth thereof representing the product packaging zone,
 - sealing means of the mouth of the open end of the tubular casing,
 - connection means placed between the sealing means and the tubular casing,
 - packaging means of a desiccant agent placed on the inner face of the sealing means,
 - a collar type outer peripheral stop, created in the vicinity of the open end of the tubular casing whereon the sealing means are supported in the closed position,
- characterised in that:

a) the sealing means of the open end of the tubular casing consist of a cap-lid coaxial with the tubular casing, consisting of an upper end wall and two concentric tubular peripheral walls, one inner wall and one outer wall, forming together a deep peripheral groove having walls distanced from each other to cover, when said sealing means are closed, the peripheral wall of the open end of the tubular casing up to the peripheral stop, creating four successive surface to surface type tightness peripheral zones forming four successive tightness barriers between the open end of the tubular casing and the cap-lid, so that a tight and close contact is established between:

- the base of the groove and the peripheral edge of the open end of the tubular casing,

- the inner surface of the inner concentric wall of said groove and the inner surface of the open end of the tubular casing,

- the inner surface of the outer concentric wall of the groove and the outer surface of the open end of the tubular casing,

b) the connection means between the tubular casing and the sealing means consist of a mechanical hinge, preferentially removable, ensuring the precision of the closure.

Detailed description of the invention

The underlying problem observed during the use of desiccant containers for the packaging of products sensitive to ambient moisture is associated with:

- the more or less rapid ability to ensure the adsorption of the ambient moisture present inside the

container, by the dehydrating agent, during container opening/closing cycles and

- the efficiency of the sealing means in terms of tightness between the long frequency opening/closing cycles, to prevent gas/gas exchanges between the inside and outside of the closed container liable to induce a change in the relative moisture level present inside the container.

This underlying problem finds a solution in the desiccant container according to the invention due to a novel combination of known or unknown means involving:

- firstly, the increase of the tightness of the closed container by the creation of sealing means with a specific architecture, guided by a removable mechanical hinge during opening/closing cycles, and stabilised at the limit by the outer peripheral stop,

- secondly, the adsorption kinetics of the inner relative moisture (which is increased) by the appropriate choice of desiccant agent and of the position thereof inside the container.

According to the invention, the tightness between the casing and the sealing means in the closed position is increased by a novel architecture of said sealing means.

The sealing means created for the desiccant container according to the invention is neither female type nor male type, as recommended by the prior art, but is distinguished significantly from the prior art in that its novel architecture provides it with four peripheral zones of close contact with the tubular casing forming the receptacle to be closed of the desiccant container, said four peripheral surface to surface type close

contact zones forming four barriers acting in mutual reinforcement to increase tightness.

For this purpose, the selected sealing means are cap-lid type, comprising an upper end wall with a cross-section adapted to that of the tubular casing to be closed. Said upper end wall is equipped with two walls, forming skirts, one of the wall forming the outer wall and the other wall forming the inner wall, which are peripheral and tubular, concentric and coaxial with the tubular casing and which form a deep peripheral groove wherein the base is the inner face of the upper end wall.

When the sealing means are in the closed position, the peripheral wall of the open end of the tubular casing is covered by the deep peripheral groove along four surface to surface type close peripheral contact zones providing increased tightness due to their individual actions which are completed mutually.

The first surface to surface type tightness close peripheral contact zone, which forms a tightness barrier, is established between the inner face of the outer wall of the deep peripheral groove and the outer face of the wall of the open end of the tubular casing, the outer wall of the groove being geometrically located on the upper end wall of the cap-lid such that the almost surface to surface contact is complete, close and immediate on closure.

The second surface to surface type tightness close peripheral contact zone, which forms another tightness barrier, is created between the base of the deep groove and the peripheral edge of the open end of the tubular casing such that the contact between said base of the

groove and the peripheral edge is also complete, close and immediate on closure.

The base of the groove may have the same cross-section as the cross-section of the peripheral edge of the open end of the casing.

According to the invention, the peripheral edge of the open end of the casing may be:

- in the prolongation of the tubular casing,
- or protruding internally and/or externally from the tubular casing.

Whether the peripheral edge of the open end of the casing is in the prolongation of or protruding externally and/or internally from said casing, the cross-section of said peripheral edge may have sharp angles, or be in an arc of a circle, of the semicircular type or greater than a semicircle.

In addition, the distance between said inner and outer walls of the deep groove is determined by the thickness of the wall of the tubular casing: this distance between walls may be equal to or very slightly greater than the thickness of said casing.

In this way, the distance between said concentric tubular walls of the cap-lid requires a slightly forced passage of the peripheral edge of the open end of the casing when the cap-lid closing operation is being performed.

The third surface to surface type tightness close peripheral contact zone, which also forms a tightness barrier, is established between the inner surface of the inner wall of the deep peripheral groove and the inner surface of the wall of the open end of the tubular casing, the inner surface of the inner peripheral wall of said

groove being the surface placed in contact, according to a surface to surface type, with the corresponding inner surface of the wall of the open end of the tubular casing. The tight contact surface created in this way is
5 peripheral and may have the appearance of a strip of a possible height extending from the lower end of the inner wall of the groove to the base of the groove.

Indeed, it has been observed that, when this type of abovementioned surface to surface tightness is created
10 inside the tubular casing at its open end, a mechanical force, even slight, applied to the cap-lid, in the direction of the opening of said cap but without causing said opening, induces an increase in the tightness by increased pressure of the inner peripheral wall of the
15 groove on the inner surface of the open end of the casing.

Otherwise, when this type of surface to surface tightness is created outside the tubular casing, even slight mechanical stress on the cap-lid induces initial separation between the outer wall of the deep peripheral
20 groove and the outer surface of the open end of the tubular casing, inducing a loss of tightness by the creation of a gaseous leak between the inside and outside of the packaging casing.

This third surface to surface type tightness close
25 contact zone, specific to the invention, is particularly effective given that the inner wall of the deep peripheral groove has a height at least equal to and preferentially greater than that of the outer wall of the deep peripheral groove.

30 To increase the surface to surface tightness further between the inner surface of the inner peripheral wall of the groove and the inner surface of the open end of the

tubular casing, the inner surface of the wall of the groove is equipped with an annular type peripheral protuberance which can engage into a corresponding peripheral groove placed on the inner wall of the open
5 end of the casing and which further completes the reinforcement of the tightness of the device inside the tubular casing.

In this way, this architecture of the cap-lid with a deep peripheral groove enables a tight overlap in three
10 peripheral surface to surface contact zones of the open end of the tubular casing, as the distance between both outer and inner walls of the peripheral groove is determined by the thickness of the wall of the open end of the tubular casing to be covered by said groove. The
15 surface to surface close contact, during the closure of the cap-lid, is established by sliding one wall over the other.

The depth of the groove, in order to be particularly effective, is selected from a range representing 45% to
20 95% of the thickness of the cap-lid measured on the outer peripheral wall of said groove.

The fourth surface to surface type tightness close peripheral contact zone which forms another tightness barrier is created by means of the contact of the plane
25 lower edge of the outer wall of the groove with the plate of the outer peripheral stop. This peripheral stop is placed at a distance from the open end of the casing such that the plane lower edge of said outer wall of the groove comes into contact with the plate of the stop,
30 said surface to surface contact forming a tightness barrier.

To facilitate the opening and closing operation of the cap-lid, the plane lower edge of the outer wall of the groove can be prolonged by a gripping visor.

To keep the cap-lid in the closed position, the
5 inner face of the outer wall of the groove and the outer face of the outer wall of the tubular casing are equipped with snap-on means, requiring a mechanical force both to complete the closure of the cap-lid with increased tightness and to open it.

10 According to the invention, the increase of the tightness between the tubular casing of the container and the sealing means in the closed position may also be increased by the presence, between the tubular casing and the sealing means, of relatively rigid, preferentially
15 removable, connection means of the mechanical hinge type.

The rigid mechanical hinge according to the invention, which is preferentially removable, is formed by two parts, one incorporated in the tubular casing, the other incorporated in the sealing means with increased
20 tightness.

The part of the hinge incorporated in the tubular casing, referred to as the male part, consists of two bracket plates, e.g. in the form of a lug, located on the outer face of the tubular casing, and in the vicinity of
25 the open end of said casing, to enable the assembly of the female part and its operation. These two bracket plates are connected to each other by a rotation axis, the ends of the axis may extend beyond said bracket plates.

30 The part of the hinge incorporated in the sealing means with increased tightness referred to as the female part, consists of:

- two bracket plates, each possibly equipped with an orifice if the rotation axis of the part of the hinge incorporated in the tubular casing exceeds, in length, the gap between the bracket plates supporting said axis, both bracket plates possibly equipped with orifices being placed at a distance with respect to each other such that they can encompass the bracket plates supporting the rotation axis,

- a deep groove, outside the deep peripheral groove of the sealing means, intended to receive the rotation axis, of a length at most equal to the gap existing between the inner faces of the bracket plates supporting said axis.

During the assembly of the sealing means on the tubular casing of the desiccant container according to the invention, the groove of the so-called female part of the hinge fits onto the axis supported by the bracket plates of the so-called male part of the hinge, and the orifices of the bracket plates of the so-called female part of the hinge receive the ends protruding from the rotation axis, when they exist, thus ensuring excellent operation around the sealing means axis.

Such a type of mechanical hinge, preferentially removable, ensures improved closing (and opening) operation of the fitting of the cap-lid on the casing using only one finger of the hand holding the container, by means of perfect mechanical guiding of said cap-lid, only requiring, to complete the closure, vertical downward pressure, causing the cap-lid to snap on. It must be specified that, according to the prior art, removable caps or cap-lids connected by flexible means to

the tubular casing, require, to be closed or opened, the use of both hands.

Such a type of mechanical hinge, referred to as a precision hinge for the closure of a desiccant container, creates and increases the tightness of said container since this type of mechanical hinge guides the cap-lid until it is completely closed by creating four surface to surface type tight and peripheral contacts mentioned above, and thus establishing four tightness barriers.

10 Finally, so that the desiccant container according to the invention is very effectively desiccant, the choice of desiccant agent and its location in the desiccant container are absolutely decisive.

According to the invention, the desiccant agent used in the desiccant container is selected from the group consisting of silica gels, molecular sieves presented in a powder form or deposited on a powder substrate.

Also according to the invention, the desiccant agent is preferentially placed in a suitable housing, preferentially of a tubular type, located on the inner face of the sealing means, said housing being closed by sealing means not tight with respect to ambient moisture to ensure the rapid drying of the moisture-sensitive products packaged in the desiccant container.

25 The desiccant container according to the invention is produced using plastics technology methods suitable for the production thereof using materials which are thermoplastic polymers and/or copolymers such as for example polyethylenes (PE), polypropylenes (PP), ethylene/propylene copolymers and mixtures thereof, 30 polyamides (PA), polystyrenes (PS), acrylonitrile-butadiene-styrene copolymers (ABS), styrene-acrylonitrile

copolymers (SAN), polyvinyl chlorides (PVC), polycarbonates (PC), polymethyl methacrylate (PMMA), polyethylene terephthalates (PET), used alone or in a mixture according to their compatibility.

5 These polymers and/or copolymers may be associated, for the production of the desiccant container and according to the desired mechanical characteristics for said container, with at least one thermoplastic elastomer of natural or synthetic origin. The elastomer(s) used may
10 preferentially be selected from the group consisting of elastomers such as natural rubbers, synthetic rubber, particularly mono-olefin rubbers, such as, for example, isobutylene/isoprene polymers, ethylene vinyl acetate (EVA), ethylene propylene (EPR), ethylene propylene diene
15 (EPDM), ethylene-ester acrylates (EMA-EEA), fluorinated polymers, diolefin rubbers, such as, for example, polybutadienes, styrene-butadiene copolymers (SBR), condensation product-based rubbers such as, for example, polyester and polyurethane thermoplastic rubbers,
20 silicones, styrene rubbers, styrene-butadiene-styrene (SBS) and styrene-isoprene-styrene (SIS) and other rubbers.

 According to the invention, the tubular casing and the cap-lid may be produced with polymer materials of the
25 same composition or with polymer materials of different compositions.

 The invention will be understood more clearly through the detailed description of the figures mentioned below, these figures only having the non-restrictive
30 illustrative nature of a particular desiccant container according to the invention.

- Figure 1 is a perspective view of the desiccant container in the closed position.

- Figure 2 is a perspective view of the desiccant container in the semi-open position.

5 - Figure 3 is a perspective view according to a diametrical cross-section of the desiccant container in the closed position packaging moisture-sensitive products.

10 - Figure 4 is a diametrical cross-section of the desiccant container according to the invention, wherein the cap-lid is raised to enable the housing of a larger quantity of desiccant agent without decreasing the effective volume intended for the packaging of moisture-sensitive products.

15 - Figure 5 is an isometric perspective view of the so-called male part of the removable mechanical hinge attached to the tubular casing.

- Figure 6 is an isometric perspective view of the so-called female part of the removable mechanical hinge attached to the cap-lid.

20 - Figure 7 is a perspective bottom view of the so-called female part of the removable mechanical hinge attached to the cap-lid.

25 - Figure 8 is a perspective top view of the so-called male part of the removable mechanical hinge attached to the tubular casing.

- Figure 9 is a perspective view along an axial cross-section of the fitted mechanical hinge, the cap-lid, in the closed position, being raised to enable the housing of a larger quantity of desiccant agent.

30 - Figure 10 is a perspective view along a cross-section, on a bracket plate attached to the tubular

casing, the cap-lid being raised to enable the housing of a larger quantity of desiccant agent.

According to figures 1 to 4, the desiccant container with increased tightness for the packaging of products sensitive to ambient moisture consists of:

- a tubular casing 1 closed at one of its ends by a base 2 and open at the other end 3 to enable the access of the tubular casing 1 for packaging the moisture-sensitive products,
- 10 - a cap-lid 4, attached to the tubular casing 1 by a removable mechanical hinge 5,
- a capacity chamber 6 intended to receive the dehydrating agent, this housing being placed on the inner face of the cap-lid 4,

15 The increase in the tightness between the tubular casing 1 of the desiccant container and the cap-lid 4 is obtained by means of a specific architecture of said cap-lid 4 (according to figures 1 to 10).

 The specific architecture of the cap-lid 4 relates to the creation of two concentric peripheral walls, of the tubular type, one of the walls 9 being referred to as the inner wall, the other wall 10 being referred to as the outer wall. Both concentric walls 9 and 10 create a deep peripheral groove 11 together, closed by the inner face of the upper end wall of the cap-lid 4.

25 When the cap-lid is in the closed position, the peripheral wall 12 of the open end of the tubular casing 1 is covered by the deep peripheral groove 11, creating four surface to surface type close contact zones, providing increased tightness between the outside and the inside of the container, due to this accumulation of tight barriers.

The first surface to surface type close peripheral contact zone forming the first tightness barrier is established between the inner face of the outer wall 10 of the peripheral groove 11 and the outer face of the wall 12 of the open end of the tubular casing 1 such that the surface to surface close contact is complete and immediate when the cap-lid is closed.

The second surface to surface type close peripheral contact zone forming the second tightness barrier is created between the base of the deep peripheral groove 11 and the peripheral edge 30 of the open end of the tubular casing 1. The contact between the base of the peripheral groove 11 and the peripheral edge 30 of the open end of the tubular casing 1 is complete on the periphery when the cap-lid 4 is closed.

In fact, according to the invention, the base of the peripheral groove 11 has the same cross-section as the peripheral edge 30 of the open end of the tubular casing 1, which in this case is a section in the form of an arc of a circle protruding laterally with respect to the open end of the tubular casing: in this way, the cross-section of the groove base is perfectly adapted to the cross-section of the peripheral edge 30.

The third surface to surface type close peripheral contact zone, forming the third tightness barrier is established between the inner face of the inner wall 9 of the peripheral groove 11 and the inner face of the wall 12 of the open end of the tubular casing 1, the inner wall 9 of the groove 11 being placed in contact with the upper end wall of the cap-lid, said surface to surface type contact being immediate and complete when the cap-lid is closed. In this way, the inner surface of

the inner wall 9 of the groove 11 is placed in peripheral contact, on practically its entire height, according to the type of surface to surface contact with the corresponding inner surface of the wall of the open end
5 of the tubular casing 1.

Along this third peripheral contact zone, it should be noted that the height of the inner wall 9 of the peripheral groove 11 is slightly greater than the height of the outer wall 10 of the peripheral groove 11.

10 It should also be noted that the inner surface of the wall 9 of the peripheral groove 11 is equipped in its lower part with a peripheral protuberance 31 which is engaged into a groove 32 present on the inner surface of the wall of the tubular casing 1.

15 The fourth surface to surface type close peripheral contact zone, forming the fourth tightness barrier, is created by the contact between the plane lower edge 20 of the outer wall 10 of the peripheral groove 11, and the plate of the peripheral stop 7 of the tubular casing 1,
20 said surface to surface type contact being peripheral, immediate and complete when the cap-lid is closed.

According to figures 5 to 10, the rigid removable mechanical hinge 5 which ensures the exact positioning of the cap-lid and the guiding thereof until the cap-lid is
25 completely closed, is demonstrated to be formed by two parts, one incorporated into the tubular casing 1, the other incorporated into the cap-lid 4 with increased tightness.

The part of the hinge 5 incorporated into the
30 tubular casing 1 consists of two bracket plates 13 located on the outer face of the tubular casing 1, notching the peripheral stop 7. Both bracket plates 13

are crossed by a rotation axis 15, the end 19 of the axis 15 protruding from said bracket plates 13, this axis and the protruding ends 19 ensuring the assembly and enabling the disassembly of the part of the hinge 5 incorporated
5 in the cap-lid 4.

The part of the hinge 5 incorporated into the cap-lid 4 consists of:

- two bracket plates 17, each equipped with an orifice 18, capable of receiving the ends 19 of the
10 rotation axis 15. The bracket plates 17 are at a distance from each other such that they encompass both bracket plates 13 of the part of the hinge 5 incorporated in the tubular casing 1,

- a deep groove 16 delimited by the inner wall 10
15 and outer walls 4, said groove being separate from the peripheral tightness groove 11, and having the inner wall 10 common and in the continuity of the outer wall 10 of the deep peripheral tightness groove 11, the length of said groove 16 being at most equal to the distance
20 existing between the bracket plates 13 supporting the rotation axis 15, these two bracket plates 13 finding their position in the two gaps 20 created between the bracket plates 17 and the deep groove 16.

In this way, according to figures 1 to 10, it
25 appears that the outer wall 10 of the deep peripheral groove 11 is broken by both gaps 20 created to house the bracket plates 13, said double rupture gap 20 not inducing a loss of the increased tightness according to the invention. However, the outer wall 10 of the deep
30 groove 11 is desirably continuous, i.e. free from notches 20.

The assembly of the tubular casing 1 and the cap-lid 4 is performed by positioning said cap-lid on the open end 3 of the tubular casing 1 through the action of a vertical pressure onto said cap-lid 4. Under the effect of this pressure, both protruding ends 19 of the axis 15 are engaged simultaneously into the orifices 18 of the bracket plates 17 at the same time as the axis 15 is engaged into the deep groove 16 of the hinge 5, by the elastic deformation of the polymer materials used to produce the tubular casing 1 and the cap-lid 4 of the desiccant container according to the invention.

The opening and closing operation of the desiccant container according to the invention is performed by mobilising a single hand, two fingers of which grasp the tubular casing, the thumb acting alone and freely on the cap-lid to perform opening and closing.

Comparative example:

- The purpose of this example is to confirm the increase in the tightness of the desiccant container according to the invention with respect to a desiccant container based on the prior art.

- The desiccant container belonging to the prior art is produced by means of injection-moulding of a thermoplastic polymer material which is polypropylene and consists of:

- a tubular casing,
- a female type cap-lid,
- connection means between the tubular casing and the cap-lid which consist of a thick strip of the same polymer, said thick strip acting as a flexible hinge,

- The desiccant capability of said container is obtained by moulding a desiccant polymer composition on the inner wall and the inner base of the tubular casing.

The moulded desiccant polymer composition consists
5 of:

- polymer matrix: 50% polyethylene by weight
- desiccant filler dispersed in the polymer matrix: 50% by weight.

The desiccant container according to the invention
10 is produced by injection-moulding of the polymer material which is polypropylene, the desiccant filler being, in one test, silica gel and, in another test, molecular sieves, in an exactly identical quantity as that of the desiccant fillers dispersed in the desiccant polymer
15 formulation used in the prior art.

Finally, the mass of the desiccant agents, used in the prior art or in the invention, is the same in both cases.

The tests using desiccant containers are carried out
20 under the same environmental conditions, i.e. at a controlled temperature of 25°C and a controlled humidity level of 80% relative humidity.

Each desiccant container (according to the prior art and the invention) is equipped with a thermo-hydrometric
25 probe inserted via an orifice formed in the base, and sealed after the insertion of the probe.

The desiccant containers equipped with their measurement probe were placed in a close confinement subjected to the above mentioned temperature (25°C) and
30 humidity (80%) conditions:

- open to stabilise in terms of temperature and humidity, and then resealed,

- at the initial time T_0 , the temperatures and humidity levels were measured in each desiccant container subjected to testing,

5 - at the final time T_1 (after 30 seconds of exposure), the temperatures and the humidity levels were measured in each desiccant container subjected to testing.

The results obtained are compiled in the table below:

	Desiccant container according to the prior art coated inside with a desiccant polymer formulation	Desiccant container according to the invention containing a powder desiccant agent in the chamber 6
Test 1	Silica gel in polymer matrix. At T_0 , the relative humidity is 80%. At T_1 , the relative humidity is 42%.	Powder silica gel. At T_0 , the relative humidity is 80%. At T_1 , the relative humidity is 0%.
Test 2	Molecular sieve in polymer matrix. At T_0 , the relative humidity is 80%. At T_1 , the relative humidity is 39%.	Molecular sieve. At T_0 , the relative humidity is 80%. At T_1 , the relative humidity is 0%.

10 It appears that the moisture tightness is indeed increased in the desiccant container according to the invention.